The Sensitivity of Income Inequality to Choice of Equivalence Scales

by

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To account for the fact that a household's needs depend on its size and composition most studies on income inequality adjust the observed household incomes by equivalence scales. However, since the rationale for choosing a specific scale is rather vague the importance of testing the sensitivity of income inequality estimates to choice of equivalence scales has long been acknowledged. The sensitivity studies in the literature restrict to equivalence scales that do not depend on the income level of the reference household which means that the effect of a rise in the household size on the scale rate does not depend on whether the household is poor or rich. By using Norwegian micro-data it is shown that the introduction of an income-dependent scale produces results that are in conflict with the widespread view of robustness of results to choice of equivalence scales.

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1. Introduction

Equivalence scales are designed to adjust for differences in income needs for households of different sizes and composition. The rationale for choosing a specific scale is, however, rather vague. This fact has made researchers aware of the importance of testing the sensitivity of income inequality results to choice of equivalence scales, see e.g. Buhmann et al. (1988), Coulter et al. (1992), Jenkins and Cowell (1994) and Burkhauser et al. (1996). The results from these studies suggest that inequality rankings are only modestly affected by the choice of scale used. However, like other empirical investigations of sensitivity these studies constrain to focus on scales that are independent of the income of the reference household. The basic property of income-independent scales emerges from the effect of a rise in the household size on the scale rates which is assumed to be independent on whether the household is poor or rich. Since this assumption appears rather controversial it is important to check the robustness of income inequality results to the scale's dependency on income as well as on size and composition of the household.

Using Norwegian micro-data this paper explore whether the introduction of an income-dependent scale produces results that are in conflict with the widespread view of robustness of results to choice of equivalence scales.

2. The sensitivity of empirical results to variation in the equivalence scale

Most studies of income inequality provide estimates of summary measures of inequality, based on individual equivalent incomes that are assessed on the basis of observed disposable household income and some chosen equivalence scale. The equivalence scale is intended to adjust for differences in needs due to different household size and composition and thereby make disposable incomes comparable across individuals.

By adjusting each household's observed disposable income by its equivalence scale the distribution of observed incomes across heterogenous households is converted into a distribution of (equivalent) incomes across "homogenous" individuals. However, since equivalence scales necessarely impose strong and controversial assumptions on the relationship between household income and individuals' needs, it is important to use more than one single scale. Buhmann et al. (1988) introduce a family of equivalence scales where the scale rates are allowed to vary with the number of persons in the household. Moreover, they demonstrate that the level of inequality may be heavily affected by the choice of equivalence scale from this family[1]. However, as demonstrated by Karoly and Burtless (1995)

the trend in inequality may remain unchanged even though the level of inequality varies with the choice of equivalence scale.

The family of equivalence scales introduced by Buhmann et al. (1988) is defined by

$$e(s,a) = s^a \tag{1}$$

where s is the size of the household and a is the elasticity of the scale rate. Note that Buhmann et al. found that a wide range of scales in use, including those designed by official agencies such as the Bureau of Labor Statistics and the Organization for Economic Cooperation and Development, can be summarized quite well by the parametric family (1). In this paper we use (1) with a equal to 0.5, called the square root scale, which is in line with common practice in recent studies.[2]

The sensitivity studies in the literature seem to focus exclusively on equivalence scales that vary with the size of the household. In some cases the scale rates are also allowed to vary with the age of the household members.[3] These equivalence scales may nevertheless be considered as rather restrictive since they all assume that the scale rates are independent of the level of income. This means that the effect of a rise in the household size on the scale rate does not depend on whether the household is poor or rich. Results based on subjective income evaluation data indicate, however, that the household size effect on the costs of reaching a specific welfare level is larger when the household is poor rather than rich.[4] This is simply due to the fact that poor households have to give priority to basic goods like food and clothing, which explains why there is a stronger relationship between expenditures on necessities and household size for poor than for rich households. The conventional equivalence scales ignore this relationship, which in order to be captured requires that the scale rates vary with income.

Figure 1 displays two time-series of Gini coefficients which rely on different equivalence scales. One is based on the square root scale, whilst the other is based on an income-dependent scale. The latter is designed to adjust for differences in the minimum incomes that are required to cover expenses on necessities and is defined by

$$E\left(z, y(z_0)\right) = 1 + \frac{m(z) - m(z_0)}{y(z_0)}, \tag{2}$$

where $m(z_0)$ and $y(z_0)$ is the minimum income and the disposable income of the reference household (z_0) and m(z) is the minimum income of household type z. Note that (2) can be

justified from consumer behavior and have been denoted the LES-scale due to its close relationship to the linear expenditure system[5]. However, we rely on decisions made by the Norwegian Parliament rather than observed households' consumer behavior in assessing the minimum incomes of different household types. We use the social security pension (minimum public old-age pension) of singles as the minimum income of single individuals. Note that single individuals define the reference household. For households with two or more members the minimum income is defined to be the sum of minimum attainable social security pensions and child allowances (included parent's tax deduction). This means that the LES-scale accounts for household composition as well as household size and moreover allows that the impact of household composition and size varies with household income[6]. Based on public pension and child allowance rates for 1991 we get the following scale rate for households with two adults and two children,

$$E = 1 + \frac{95389}{y_0}, \tag{3}$$

where y_0 is the disposable income of a single individual (the reference household) and 95389 is the difference in minimum income (1991-NOK) between the four-person and a one-person household. Table 1 demonstrates how the scale rates for a household with two adults and two children vary with the income of a single individual. Note that the corresponding scale rate of the square root scale is equal to two irrespective of whether the four-person household is compared with a poor or rich single individual.

The LES-scale defines the individual equivalent income to be equal to the observed household income subtracted the difference between the minimum income of the related household type and the minimum income of single individuals. This means that the scale rates decline towards unity when the income increases.

Although the structures of the LES-scale and the square root scale are rather different, Figure 1 shows the estimated trend in the Gini coefficient to be unaffected by the choice of equivalence scale. However, when focus is changed from the entire population to children below 16 years then Figure 2 shows that both the level and the trend in income inequality are sensitive to the choice of equivalence scale. Income inequality remains stable from 1982 to 1988 and increases slightly from 1988 to 1991 when incomes are adjusted by the square root scale. By contrast, when the square root scale is replaced by the LES-scale the estimated Gini

coefficients show to decline markedly from 1982 to 1988. This result is in conflict with the widespread view of robustness of results to choice of equivalence scales.

Footnotes

[1] See also Burkhauser et al. (1996).

[2] See e.g. Atkinson et al. (1995).

[3] See Jenkins and Cowell (1994).

[4] See Van Praag and Van der Saar (1988) who provide empirical evidence from OECD countries.

[5] Conniffe (1992) gives theoretical arguments in favor of income-dependent equivalence scales when consumer behavior is consistent with the LES or the AIDS.

[6] Burkhauser et al. (1996) report equivalence scales based on the extended linear expenditure system. These scales appear, however, to be converted to be constant with income.

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Figure 1. Income inequality in Norway 1985-1994. Gini coefficients

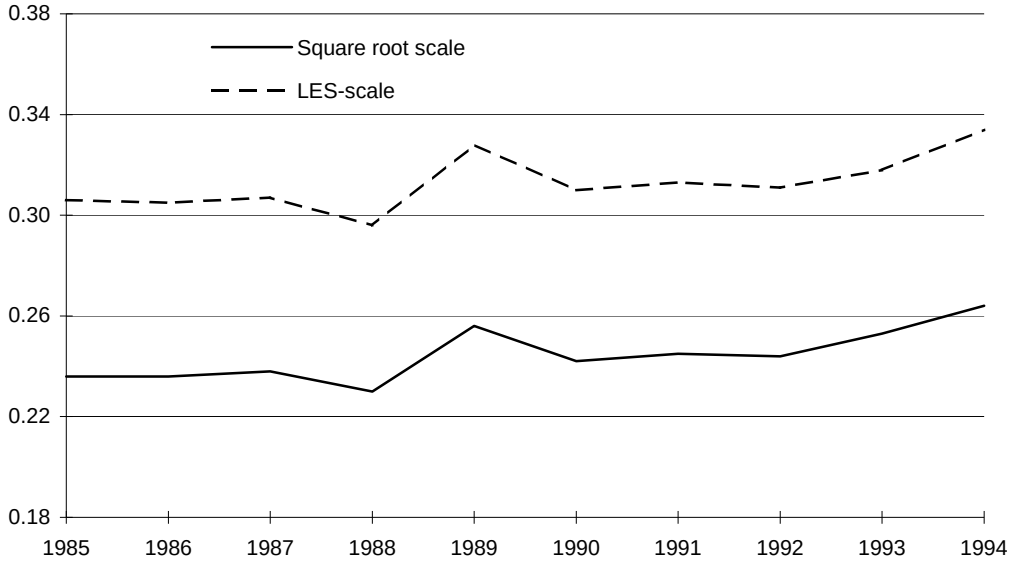

Table 1. LES- scale rates for a household with two adults and two children by the income of the reference household

	Disposable income of the reference household (1 000 NOK)						
	50	100	150	200	300	500	1000
Scale rates	2.91	1.95	1.64	1.48	1.32	1.19	1.10

Figure 2. Income inequality among children in Norway 1982-1991. Gini coefficients